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ABSTRACT

Among the articles in this newsletter are three concerned with the decrease in federal funding of the mathematical sciences. A review of a report, Information Needs in the Mathematical Sciences, is provided in another article. (DT)

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Newsletter

Conference Board of the Mathematical Sciences

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THE PROBLEM OF SUPPORT FOR THE MATHEMATICAL SCIENCES

[Pursuing the forum aspect of its role, the *Newsletter* is happy to feature the following thoughtful position paper by Lowell J. Paige, Dean of Physical Sciences at the University of California, Los Angeles, and chairman of the American Mathematical Society's Committee on Relations with Government. -- Ed.]

One year as a member of the American Mathematical Society's Committee on Relations with Government has convinced me that any national science policy which the United States may profess, and the subsequent implications for fiscal support of the mathematical sciences, are determined as much by the Office of Management and Budget as they are by the National Science Board, the National Academy of Sciences, the President's Science Advisory Committee, the Office of Science and Technology, or the several scientific societies. The influence of OMB in its annual negotiations with federal agencies during the preparation of the budget and its ability to impound funds and delay spending for congressionally approved programs obscure the advice on science policy from traditional sources. Let me illustrate my point.

The National Science Board has stated* what it believes to be the basic tenets of the United States science policy:

a. The United States will strive to remain competitive at or near the forefront of each of the major areas of science and, to this end, will continue to identify and support scientific excellence.

b. The Nation is committed to the principle that every young person should have the opportunity to pursue advanced education to the extent of his ability and motivation irrespective of geographic origin or economic means.

c. The Federal Government has a responsibility to ensure that new scientific knowledge is utilized as rapidly and effectively as possible in support of national goals and for the welfare of the world's peoples.

With respect to graduate education, the Board has urged** the adoption of a statement of national policy which reads in part:

> It is the policy of the United States that the Federal Government, in cooperation with State Governments and all other participating institutions, shall encourage and financially support the conditions essential to graduate education: the fruitful and mutually strengthening associations of student and teacher, of research and society.

The President's Task Force on Science Policy supported the adoption of the National Science Board's recommendation on graduate education as an expression

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*_The Physical Sciences_, a Report of the National Science Board to Congress, U.S. Government Printing Office (1970), p. ix.

**_Toward a Policy for Graduate Education in the Sciences_, A Report of the National Science Board, U.S. Government Printing Office (1969), p. 26.

of national policy in its April 1970 report.*

The President's message to Congress that spring on Science and Technology has been referred to by Edward E. David, Jr., the President's Science Advisor, as a "landmark"; and, he also added, "It represents the foundation for a coherent science policy for the United States and a clear cut recognition that science policy is an integral part of our overall national policies." I quote two of the six specific points the President stressed in his opening remarks:

> A fourth consideration concerns the need for scientific and technological manpower. Creative, inventive, dedicated scientists and engineers will surely be in demand in the years ahead; young people who believe they would find satisfaction in such careers should not hesitate to undertake them. I am convinced they will find ample opportunity to serve their communities and their country in important and exciting ways.
>
> The fifth basic point I would make concerning our overall approach to science and technology in the 1970's concerns the importance of maintaining that spirit of curiosity and adventure which has always driven us to explore the unknown. This means that we must continue to give an important place to basic research and to exploratory experiments which provide the new ideas on which our edifice of technological accomplishments rests. Basic research in both the public and private sectors today is essential to our continuing progress tomorrow. All departments and agencies of the Federal Government will continue to support basic research which can help provide a broader range of future development options.

How does one reconcile the preceding statements of science policy with the following fiscal realities?

a. The abandonment of the NDEA Graduate Fellowship program;

b. The reduction of the number of NSF Graduate Fellowships for *all* fields of science to 500 new awards each year, roughly half the former number;

c. The abolishment of nearly all NSF postdoctoral fellowship programs;

d. A significant reduction in the support of science education programs;

e. The relative decrease in the funding for basic research despite an overall increase in Research and Development support.

The President's message on Science and Technology dealt primarily with programs designed "to ensure that new scientific knowledge is utilized as rapidly and effectively as possible in support of national goals and for the welfare of the world's peoples" (the National Science Board's third tenet of science policy), and it is not unexpected that the emphasis should have been

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*_Science and Technology: Tools of Progress_, A Report of the President's Task Force on Science Policy, U.S. Government Printing Office (1970).

on applications and applied research. The mathematical community has been admonished for several years to consider its responsibility toward interdisciplinary research and a training of graduate students more responsive to society's needs. Nonetheless, it is worth noting the trend in the percentage of the National Science Foundation's Scientific Research Projects budget that has been allocated to mathematics (and this includes applied mathematics and statistics):

Percentage of NSF's Scientific Research Projects Budget for Mathematics

Fiscal Years				
1969	1970	1971	1972	1973
7.22%	7.83%	7.46%	5.11% (Est.)	5.23% (Est.)

The dollar amount of support for research projects in mathematics has grown from $12.7 million in 1969 to an estimated $14.4 million in fiscal year 1973; however as pointed out in the March 1971 CBMS *Newsletter* (p. 2), this increase is hardly sufficient to keep abreast of inflation and woefully inadequate to support the projects shifted to NSF as a consequence of the Mansfield amendment as well as the new active research mathematicians graduated in the past five years.

My detailed observations have focused on basic research support, and I imagine that a comparable analysis of support for the mathematical sciences in undergraduate education, curriculum improvement and innovation, information systems and publication would reveal similar distressing trends. There is little evidence to suggest that those in positions of science policy formulation have taken the recommendations of the COSRIMS Report* on the mathematical sciences very seriously. One point is clear: there is a growing tendency on the part of federal agencies to establish and modify science policy after little consultation or, and here I am being generous, after very selected consultation with the scientific community. I am not optimistic that we can be successful in persuading those responsible for science policy to undertake a more thorough consultation with the scientific community on matters of either specialized or general concern; nor am I certain that a convincing brief can be presented which will justify support for the mathematical sciences of a character different from that afforded other sciences. I am convinced that both efforts should be made or we can expect further erosion in support relative to our needs. In support of these efforts, I believe it is important that the mathematical community have available: (a) an assessment of priorities for problems internal to the mathematical sciences; and (b) a well documented brief for the character of support needed for the mathematical sciences. I urge the several mathematical societies and the Conference Board of the Mathematical Sciences to proceed with these tasks. It would be premature for me to suggest the nature of the documentation these deliberations should provide, but we must recognize and accept the fact that there will be a continuing and growing emphasis on applications of science and interdisciplinary approaches to the problems of society. In what follows, I have a few comments to make on both tasks which I have urged upon the mathematical community.

*_The Mathematical Sciences: A Report_ and _The Mathematical Sciences: Undergraduate Education_, Reports of the Committee on Support of Research in the Mathematical Sciences (COSRIMS), National Academy of Sciences (1968).

Priorities in the Mathematical Sciences

It is important that we in the mathematical sciences assume the responsibility for recommending priorities among our own competing needs if we seek a reasonable stability in program support or if we expect to exert any influence on science policy -- a policy which, in the past, has at times encouraged the initiation of projects of doubtful value *ab initio* and for which continuing support has evaporated. For such an attempt to establish priorities in the mathematical sciences any guidance to be found in the pre and post sputnik decades is minimal. The generous fiscal support rendered all of the sciences in that era made priority decisions in the mathematical sciences a matter of scarcely noticeable concern. The modest requirement of the mathematical sciences relative to "big science" made it possible for practically any program directed at the improvement of mathematical education, graduate student aid, or the encouragement of basic research to find support. Today, the problems of unemployment, underemployment and the non-retention of our younger colleagues in colleges and universities are ominously present at discussions of program support in all fields of science. Within the mathematical community, it is clear from the data provided by Professor R. D. Anderson* that decreasing educational employment opportunities account for many of our unemployed.

In the face of limited resources, conflicts are certain to arise between the immediate concern for our unemployed colleagues and (i) the needs of ongoing research programs; or (ii) the requests for support from new interdisciplinary groups; or (iii) the requirements of affirmative action with respect to employment opportunities for women and members of ethnic minorities; or (iv) the funding of postdoctoral research opportunities; or (v) the financial assistance provided graduate students; or (vi) the desirability of continuing aid to developing departments; or (vii) the demands for the improvement of science education; or (viii) the support of educational opportunities for ethnic minorities. All of these considerations and others, since my listing is not intended to be complete, make it imperative that a discussion of priorities be undertaken in as broad a spectrum of the mathematical community as possible. I am not certain which of our problems should receive the most attention. There is always the danger that a concentration on immediate needs will, in the end, be detrimental to the vitality of the mathematical sciences and a severe handicap of our research capability. However, I am certain that those responsible for resource allocation are little moved by recommendations which may be interpreted to be in our narrow self-interest. Again, let me illustrate my point.

The Council of the AMS has suggested that mathematics departments can help ameliorate educational employment opportunities, both today and in the future, by creating junior positions at the expense of teaching assistantships. This recommendation seems very reasonable at first glance, but I am afraid the Council has underestimated the budgetary problems facing many departments. First, the reduced funding of fellowships and research assistants has forced several departments to seek additional teaching assistantships from their administrations in order to support presently enrolled graduate students. Secondly, the Committee on Employment and Educational Policy of the AMS has suggested to departments that they inform students of the bleak outlook for employment opportunities in the mathematical sciences. This will unquestionably lead to a decreasing number of undergraduate majors and graduate students in mathematics. Few administrations will interpret this decrease, combined with

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*"Academic Employment Prospects for September 1972" by R. D. Anderson, *Notices of the American Mathematical Society*, Volume 19, Number 2, p. 116 ff.

changing course demands due to more open enrollments, as convincing arguments to increase the number of junior faculty positions in mathematics. A more likely reaction will be to decrease the number of faculty positions and to suggest that senior faculty increase their teaching lead at the undergraduate level.

It is not clear to me that the gloomy employment prospects pictured for mathematics majors also hold for majors in statistics and computer science. I I would suggest that employment problems, both with respect to immediate needs and future prospects, are not independent of our other problems. Professor G. S. Young*, in inviting our attention to several problems faced by the mathematical community, made it quite explicit that a viable forum for the discussion of our needs is necessary if we are to have any influence on science policy. To an outsider unfamiliar with the history of the origins of our several mathematical societies, an obvious forum is the Conference Board of the Mathematical Sciences. However, Professor Young's disquieting comments concerning his experiences with CBMS and my own personal knowledge of its brief life invite caution in expecting that our several mathematical organizations have the ability or will to cooperate for our common cause. But try we must.

Funding in Support of the Mathematical Sciences

We have all heard remarks comparable to the statement that the needs of the mathematical sciences are so modest that the increase in funding needed to alleviate many of our problems is expended many times over in one Saturn launching. An equally wistful remark takes the form, "If even a small fraction of the funds allocated to experimental research in physics were reassigned to the mathematical sciences!" We need substantial arguments to justify support, not disguished criticism of government policies or expressions of envy. I am under no illusion that the preparation of a brief in support of appropriate funding for the mathematical sciences will be a simple task. We must recognize that the COSRIMS Report was, in a sense, such an attempt. One aspect of the subsequent history of this report is discouraging. A special committee of the Division of Mathematical Sciences of the National Research Council was established to consider means of implementing the recommendations of COSRIMS. This committee reported in May, 1971 that "austere economic conditions in the sciences have largely undermined this aim [the implementation of COSRIMS' recommendations]" and it was discharged. I would hope that it would be unnecessary to repeat the COSRIMS discussion of mathematics and society. Yet there are influential scientists, and some mathematicians, who feel that most of the research in the mathematical sciences is not relevant to the nation's needs. I do not know what arguments might move those who view the mathematical sciences more as an intellectual art than as a national resource. Nonetheless, I would like to point out several instances where unique treatment in support could be justified or where present practices need further investigation.

The decreasing share for mathematics in NSF's budget for Scientific Research Projects has already been mentioned. Why the decrease? It cannot be attributed entirely to the additional funding needed by other disciplines to support programs transferred to NSF as a consequence of the Mansfield amendment. It cannot be attributed to the growing emphasis on applied programs, since these are not reflected in the portion of the budget under question. One argument is that the growing delay in the potential application of mathematical research contrasts sharply with the President's admonition that "the mere act of scientific discovery alone is not enough." I would reply that the measurement of

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*"The Crisis of the Mathematical Sciences", by Gail S. Young, *American Mathematical Monthly*, Volume 78, Number 9, p. 980 ff.

differential cross-sections in high energy physics or the search for evidence of black holes in space is research which will have no more impact on the lives of today's citizens than a proof of the Goldbach conjecture. The support of research in each of these instances reflects the nation's commitment to maintain a healthy, vigorous research capability at the frontiers of knowledge for all disciplines, scientific and other.

Our concern must be to maintain the research capability of the mathematical sciences. It troubles me that the employment situation has forced talented young Ph.D.'s into positions where imaginative programs to support their research potential are lacking and the erosion of their training is inevitable. We are speaking of a national asset, and the programs for the mathematical sciences will be different from those needed in experimental fields. The necessary funding is not available today and I see only limited assistance in Senator Kennedy's National Science Policy and Priorities Act of 1972.

There is a growing reliance on large, expensive national laboratories for research at the frontiers of physics. The mathematical science analogues (not in expense but in our research efforts) are the distinguished departments. If others believe that the funding of national laboratories is critical for maintaining scientific eminence in their fields, then I believe we must argue strongly for either adequate funding of mathematical research in distinguished departments or the creation of national institutes for such research. The experience of my present position leads me to prefer the former alternative, but I can easily see where substantial arguments could be formulated to support the latter. In either case, the necessary funding is not available today.

Our needs for the support of mathematical education are unique among all of the sciences. We are the only science discipline whose subject matter is the concern of all students from kindergarten through secondary school. Our curricula cannot remain static. The growing emphasis in other disciplines on probability, statistics, linear algebra and computer science for their research efforts, imposes demands on mathematical education requiring continual assessment and review. Moreover, the changing patterns of college and university enrollment, with increased opportunity for those long denied the advantage of higher education, raise challenging questions in mathematical education. Yet, except for minor perturbations, our support in this area seems to be dictated by overall science policy. The funding is not adequate today.

Let me now turn to policies which need further investigation. It has always annoyed me that overhead charges on federal contracts are uniform for all fields of science. In a random selection of five proposals submitted through my office, I found university overhead, as a percentage of the proposed budget, to be: Chemistry, 19%; Geology, 24%; Physics, 21%; Mathematics, 29% for one and 31% for another. We all know the reason -- no overhead on equipment and supplies. If these differences in percentage are typical, then the mathematical sciences are, in reality, subsidizing other disciplines on our meager budget. Moreover, incremental budgets reflecting inflationary adjustments never take into account this characteristic of support for the mathematical sciences. We end up supporting less research.

I have heard it stated that members of science advisory groups who are not accustomed to the expensive equipment needs of the experimental sciences find the problem of resource allocation a bewildering task. Perhaps this may explain to some extent the present composition by discipline of the National Science Board: physics - 6; chemistry - 5; biology - 3; and one each from anthropology, botany, engineering, geology, geophysics, mathematics, meteorology,

political science, psychology, and one member from the humanities. Nonetheless, I find this composition surprising in view of the fact that there are considerably more faculty members in the mathematical science departments of our colleges and universities than there are faculty members in chemistry or physics. I do not mean to imply that questions of support allocation for the mathematical sciences cannot be handled impartially by others; but more readily available advice seems justified. I also do not intend that my last few points be interpreted as peevish reactions. They are meant to suggest that a brief for the adequate support of the mathematical sciences should include a searching review of present practices and policies.

-- Lowell J. Paige

SECOND INTERNATIONAL CONGRESS ON MATHEMATICAL EDUCATION

The Second International Congress on Mathematical Education, plans for which were noted in the May 1972 CBMS *Newsletter*, page 4, took place as scheduled at Exeter, England, during the period 29 August - 2 September 1972, the first such Congress having been held at Lyon, France, in 1969. The Congress was organized by the International Commission for Mathematical Instruction (ICMI) of the International Mathematical Union, acting on an invitation from the Royal Society to hold the meeting in the United Kingdom. Professor Sir James Lighthill, F.R.S., of Cambridge, England, who is President of ICMI, was Chairman of the Congress. About 1,400 full members and 300 associate members representing 66 countries were in attendance, including an estimated 400 from the United States, more than twice the number from the U.S. who attended the Lyon Congress from the U.S.

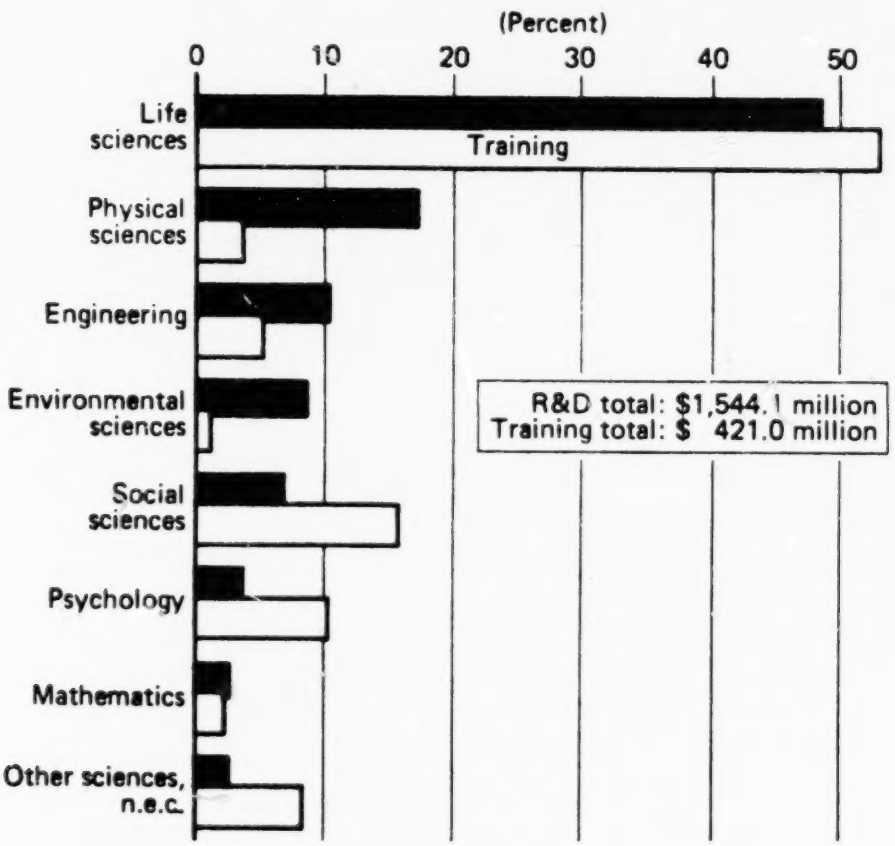
There were seven plenary sessions featuring talks by invited speakers from six countries, with simultaneous translations of these talks into English, French, and German. Professor David Hawkins of the United States spoke at the second plenary session on "Nature, Man, and Mathematics". In addition, 39 working groups were devoted to specific aspects of mathematical instruction from the primary school to the graduate school, and there were 17 National Presentations in which significant developments in various nations were described. The United States Presentation was quite extensive, with 19 speakers in 13 sessions spread over four days. There was also a continuous commercial exhibition of books and equipment for mathematical education, and a large number of mathematical films, mainly produced in the U.S.A. and Great Britain, were shown.

At the business session of the Congress, representatives from each of four nations -- the United States, the Netherlands, Spain, and Western Germany -- requested that the Third International Congress planned for 1976 be held in their country. Because of the lack of firm proposals with all necessary details and assurances from these various countries, it was decided to delay the selection of the 1976 site until the Congress Executive Committee meets next year and has more information upon which to base a determination. Dr. Henry Pollak of the United States is a member of this Executive Committee. It was also decided at the Congress that ICMI would give encouragement to several proposed Regional Conferences on Mathematical Education to be held in various parts of the world between the Second Congress of 1972 and the Third Congress of 1976. R. P. Dilworth is the U.S. representative on ICMI, and Pollak and Andrew Gleason are members at large appointed by the International Mathematical Union. All full members of the 1972 Congress will receive in due course a published report of the conference. This publication will include the plenary addresses and, for each of the working groups, a summary of approximately 1,000 words concerning the conclusions reached.

-- Clarence B. Lindquist

FIELD-DISTRIBUTION OF 1971 FEDERAL FUNDS FOR R&D AND SCIENCE TRAINING

Contributing to the factual perspective in which to view Federal support of research and education in the mathematical sciences is the following graph on the percentage breakdown by field of science of the total 1971 Federal obligations to universities and colleges for (1) research and development (upper, solid bars in the graph) and (2) fellowships, traineeships and training grants, as reported in the National Science Foundation's Science Resources Studies Highlights (NSF 72-316) issued on September 22.



The $421 million total for Federal support for fellowships, traineeships, and training grants in 1971 was distributed as follows: life sciences -- $225 million; social sciences -- $67 million; psychology -- $42 million; engineering -- $22 million; physical sciences -- $16 million; mathematics -- $9 million; environmental sciences -- $5 million; other sciences, not elsewhere classified -- $34 million. Nearly two-thirds of the $34 million total for this last category represents NSF training grants for which the field of science could not be determined at the time obligations were reported.

NSF'S GRADUATE FELLOWSHIP PROGRAM AND THE MATHEMATICAL SCIENCES

[The following is a statement circulated on 18 October 1972 to key science policy figures in the Federal Government by Nathan Jacobson, President of the American Mathematical Society.--Ed.]

The quality of research in any field of science is measured neither by the amount of support for research, nor by the number of active scientists, but by the talented people whose creative efforts provide the insight to solve old problems and to pose significant new ones. Without the opportunities provided by open competitive federally supported graduate fellowships, many of our most gifted scientifically oriented young people will find other career choices more expedient or will be tempted to settle for lesser goals which are not commensurate with their talents. This would, of course, be a tremendous loss to the nation and will certainly result in a lowering of our present pre-eminent position in science.

It is presently anticipated that the latest policies set for the National Science Foundation are likely to result in the award of approximately 500 first year graduate fellowships in all areas of science combined. If past practices are followed, this would allocate about 60 fellowships for the entire spectrum of the mathematical sciences, covering pure and applied mathematics, computer sciences, and statistics. We believe that such a level of support is far below that needed to help guarantee the entry into the field of those highly gifted young minds upon whom the long term future of a science depends.

We recognize that other avenues of support, such as teaching assistantships, will continue to provide assistance to some graduate students in training, but point out that these are closely tied to the changing demands of educational patterns of undergraduate instruction; moreover, these do not share the freedom of choice, quality of judgment, and degree of recognition provided in the NSF program.

In response to this, and feeling that the priority of this issue may place it ahead of other immediate and painful concerns, the Council of the American Mathematical Society at its recent meeting at Dartmouth, passed the following Resolution:

> That the National Science Foundation be encouraged in the strongest terms to increase the funds allocated for the competitive high level NSF Graduate Fellowship program to bring the total number granted for the combined mathematical sciences (pure and applied mathematics, computer sciences, and statistics) to 100 new awards annually; that the holders of these fellowships be permitted to continue to exercise their free choice in their selection of a graduate school; and that the allocation of these fellowships among the mathematical sciences be made in a coherent manner by a single representative panel on the basis of merit alone and not by quota.

This resolution has also been endorsed by the Council of the Conference Board of the Mathematical Sciences, representing scientific societies of the nation concerned with all areas of mathematics and its applications.

We urge that you give it your most urgent attention and consideration.

PRESIDENTIAL INTERNSHIP PROGRAM BEING DROPPED

The Administration now plans to terminate the program of Presidential Internships in Science and Engineering which was initiated last fall (January 1972 CBMS *Newsletter*, pages 3-4) to provide jobs in Federal laboratories for unemployed young scientists and engineers. The October 1 issue of *Science and Government Report* comments that the effect of this will be to increase pressure on job opportunities in a market at best only slightly improved and goes on to say that "Politically, the move means that the Administration is reverting to the position that academic science and technology must adjust to the present economic situation and not look for special relief measures."

NSF GRANT AWARDS FOR IMPROVED SECONDARY SCHOOL TEACHING

On October 10 the National Science Foundation announced the award of twenty-three grants totalling $2.3 million for Leadership Development Projects at colleges and universities designed to improve science and mathematics instruction in junior and senior high schools. Of the twenty-three projects, eight are in mathematics, two are in computer science, and two others are especially aimed at science and mathematics for supervisor-trainees. The Leadership Development Projects, an outgrowth of the Academic Year Institutes supported by NSF since 1957, reflect a new emphasis on preparing participants for leadership to improve science and mathematics instruction in their school systems.

The awards just announced will provide full-time college and university training opportunities for 357 secondary school teachers, supervisors, and resource personnel during the 1973-74 academic year. Stipends of up to $4,000 are provided for participants, with supplementary allowances for dependents and travel. Participants pay no tuition or fees, and a majority of the projects also provide coordinated summer training in addition to the academic-year program. After November 15, a directory of institutions offering Leadership Development Projects for Secondary School Teachers and Supervisors may be obtained by request to the Academic Year Study Program, Division of Pre-College Education in Science, National Science Foundation, Washington, D.C. 20550; telephone: (202) 282-7798.

AMS *NOTICES* INITIATES NEW "QUERIES" COLUMN

Implementing an idea generated by the AMS Committee to Monitor Problems in Communications, the *Notices* of the American Mathematical Society is initiating in its October 1972 issue the publication of a "Queries" column, edited by Wendell H. Fleming. The column, which will appear regularly in each issue, will be devoted to the publication of questions regarding mathematical matters such as details of, or references to, vaguely remembered theorems, sources of exposition of folk theorems, or the state of current knowledge concerning published conjectures.

When appropriate, replies from readers may be edited into a definite composite answer and published in a subsequent column. All answers received to Queries will ultimately be forwarded to the questioner. Consequently, all items submitted for consideration for possible publication in the column should include the name and complete mailing address of the person who is to receive the replies. The queries themselves, and responses to such queries, should be addressed to Professor Wendell H. Fleming, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02904.

SIAM 20TH ANNIVERSARY FEATURES CONFERENCE ON SOCIETAL PROBLEMS

As a special feature of its twentieth anniversary celebration this year, the Society for Industrial and Applied Mathematics sponsored on June 23-26 a Conference on Societal Problems at Arden House in Harriman, New York. The Conference of about 40 participants was supported by grants from the Research Foundation and the Alfred P. Sloan Foundation. The purpose was to consider in a very broad way the possibilities of considerably deeper involvement of mathematics and mathematicians in problems of our society today. More specifically, the aim of the discussions was to develop viewpoints new to the mathematical community that would illuminate areas where mathematics has had little application but where it might be able to make a positive contribution.

The keynote address at the Conference was delivered by Philip Abelson of the Carnegie Institution and *Science* magazine. Six formal presentations were given: by Roger Revelle of Harvard University, on population growth; by Jeremy Stone of the Federation of American Scientists, on peace and defense and the role of scientists in public policy; by Jan Stolwijk of Yale University, on world dynamics; by Merle Eisenbud of New York University, on the environment; by George Silver of Yale University, on health and medicine; and by Thomas Jones of the National Science Foundation, on its societal programs. A rather detailed report and commentary on the Conference, including both the formal presentations and the discussion and summary sessions, has been given by Allen Hammond, Research News Editor for *Science* magazine, in a special August 1972 issue of the SIAM *Newsletter*. Also reported in this same special issue are SIAM's Twentieth Anniversary Meeting of June 12-14 in Philadelphia and its joint meeting of June 15-16 with Drexel University, where SIAM was founded.

THE FORTHCOMING AAAS MEETING AND THE MATHEMATICAL SCIENCES

This year the annual meeting of the American Association for the Advancement of Science will take place during the period December 26-30 in Washington, D.C. Primary goals of the meeting are to review significant developments in major scientific fields and to enhance public understanding of science and technology. The core of the meeting will consist of symposia falling under thirteen major headings: Education and the Human Sciences; History, Philosophy, and Sociology of Science; Mathematics and Systems; The Physical Universe; The Living World; Health, Behavior, and Social Processes; Environmental Science; Technology; Science and Social Needs; Science Policy -- the Anatomy of Decision; Science and Social Institutions; Support for Science -- A Focus for Public Policy; and Science in the Cultural Setting. Four one-hour color television broadcasts will originate from Washington each evening of the meeting on the Public Broadcasting System, and again this year a Science Film Festival will take place.

Under the heading of Mathematics and Systems and with the cooperation of various professional societies in the mathematical sciences, the Section on Mathematics and the Section on Statistics of the AAAS are between them sponsoring some seven sessions, as follows: Methods of Social Indicator Analysis (December 26, 2:00 p.m.); An Evaluation of Forrester-type Gross Models (December 26, 2:00 p.m.); Exploratory Data Analysis (December 27, 8:30 a.m.); Statistical Methods and Problems in Ecological and Environmental Studies (December 27, 8:30 a.m.); Advances Toward Better Computing for Researchers (December 27, 2:00 p.m.); International Aspects of Mathematical Education (December 28, 9:00 a.m.); Mathematical Biology (contributed papers; December 30, 9:00 a.m. and 2:00 p.m.). As Retiring President of AAAS, mathematical scientist and administrator Mina Rees will deliver an address on the evening of December 28.

NSF SUMMER PROGRAM TO IMPROVE COLLEGE SCIENCE TEACHING

According to a very recent announcement (NSF 72-180) by the National Science Foundation, more than 1,350 teachers from colleges, universities, junior and community colleges, and technical institutes will return to school during the summer of 1973 under an NSF program designed to improve college science, mathematics, and engineering teaching. Awards totalling more than $2.8 million will support innovative summer institutes and short courses open to college teachers from throughout the country. The projects will be conducted by 45 institutions located in 25 states and the District of Columbia. Seven of these projects are in the mathematical sciences: five of them in mathematics, conducted by Carleton College, Colgate University, the Mathematical Association of America, Michigan State University and Washington State University; and two in operations research, conducted by Cornell University and by West Virginia University.

Participating teachers are expected to play key roles at their institutions to implement reforms in undergraduate education. Both short courses and summer institutes will present in depth new subject matter and new approaches to teaching methods for undergraduate instruction. Summer institutes will range in duration from four to eight weeks and short courses will last up to four weeks. A Directory (E 72-U-9) with details and schedules of summer institutes and short courses for college teachers may be obtained after 1 December 1972 by sending a request to: College Teacher Programs, Division of Undergraduate Education in Science, National Science Foundation, Washington, D.C. 20550, telephone: (202) 282-7940. Inquiries and requests for application forms should be addressed to the project directors, not to the National Science Foundation.

NRC DIVISION ISSUES ANNUAL REPORT AND FELLOWSHIP BROCHURE

The Annual Report of the Division of Mathematical Sciences of the National Research Council for the period July 1971 - June 1972, just published this month, contains a valuable full account of the Division's March 1972 symposium, which featured an address by R. D. Anderson on "Jobs for Mathematicians and the Future of Research" followed by a panel discussion. The Report also covers other activities of the Division and its various committees during the year and includes a directory and address list of members of the Division and its committees.

In September, the Division published its brochure on Fellowship and Research Opportunities in the Mathematical Sciences, which lists a number of fellowships, grants, and other kinds of support for research to be awarded during the year 1972-73. Copies of both the Annual Report and the fellowship brochure are available on request from the Division of Mathematical Sciences, National Research Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418. Other sources of support are given in the NRC Fellowship Office's Selected List of Major Fellowship Opportunities and Aids to Advanced Education (published in two versions, one for U.S. citizens and the other for foreign nationals) and in the NRC Associateship Office's flyer on Postdoctoral Research Opportunities for 1973, available from these Offices at the above Constitution Avenue address.

At the end of June, Dr. Leon W. Cohen retired as Executive Secretary of the Division and his position was taken over by Dr. Thomas Kramer. A 1971 doctorate recipient in topology from Duke University, Dr. Kramer is also Assistant Executive Secretary of the National Research Council's Division of Engineering.

PROPOSALS INVITED FOR NSF-CBMS REGIONAL RESEARCH CONFERENCES IN 1973

On August 23 the National Science Foundation issued an announcement seeking proposals for five-day Regional Conferences in 1973 on subjects of current research interest in the mathematical sciences. The objective of the Regional Conference project is to stimulate and broaden mathematical research activity, particularly in regions of the country where such activity needs further development. As in the past four years, the organization of the Conferences, evaluation of proposals, and arrangements for publication of Conference-related expository papers are to be carried out by the Conference Board of the Mathematical Sciences, Washington, D.C., under contract with the National Science Foundation.

About a dozen Conferences per year are projected, each to take place at a host institution during a summer week, or possibly within a recess of the succeeding academic year. Topics for Conferences may be concerned with one or more of the various disciplines of the mathematical sciences, including, in addition to pure mathematics, fields such as applied mathematics, statistics, computer science, operations research and management science. Each Conference should plan for a single principal guest lecturer and about twenty-five other participants, the latter to be active research mathematicians from the broad geographic region around the host institution. It is expected that the lecturer will give two lectures per day during the five days of the Conference, with the remainder of the time available for study, informal discussion and exchange of ideas.

All participants in a Conference receive allowances for travel and subsistence. The principal lecturer receives, in addition, fees for delivering his lectures and for organizing these into a substantial expository paper. The Conference Board arranges for the editing and publication of these expository papers. Inquiries regarding details of proposals for these regional conferences may be addressed to the Conference Board of the Mathematical Sciences, 834 Joseph Henry Building, 2100 Pennsylvania Ave., N.W., Washington, D.C. 20037. *Proposals by prospective host institutions should be sent directly to the Mathematical Sciences Section, (attention Dr. William H. Pell) National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550, and should be received by 1 December 1972.* Proposals will be evaluated by a panel of the Conference Board and awards of conference grants will be made by the National Science Foundation with the advice of the panel.

COMING CBMS PANEL DISCUSSION ON MATHEMATICAL MODELING IN THE DECISION SCIENCES

At the winter mathematics meetings in Dallas the Conference Board of the Mathematical Sciences will sponsor a panel discussion on Mathematical Modeling in the Decision Sciences, to be held from 1:45 p.m. - 3:45 p.m. on Sunday, January 28, 1973. At each of the three preceding winter meetings CBMS has sponsored such panel discussions, on computer science and mathematics, on operations research and mathematics, and on performance contracting and mathematics in the schools.

The forthcoming panel discussion has been arranged by Dr. Alan Goldman of the Applied Mathematics Division of the National Bureau of Standards, who has secured as panelists Dr. Thomas E. Caywood of A. T. Kearney Corporation, Dr. Gordon Raisbeck of Arthur D. Little Corporation and Professor Robert M. Thrall of Rice University. Dr. Goldman himself will serve as moderator for the discussion.

THE FIRST U.S.A. MATHEMATICAL OLYMPIAD

For fifteen years the Mathematical Association of America (MAA), in cooperation with the Society of Actuaries, and for a shorter time with the National Council of Teachers of Mathematics, Mu Alpha Theta, and the Casualty Actuarial Society, has sponsored the annual High School Mathematics Competition (AHSMC). Rapid growth has characterized the competition so that in 1972 approximately 340,000 students from 6,200 high schools in the United States and Canada participated; in addition about 15,000 students in the United Kingdom and smaller numbers in some countries of Europe, the Near and Far East, Africa, and South America took part. It has been usual for top-ranking students in the schools of the ten geographical areas in the United States and Canada to receive awards, some of substantial monetary value, in recognition of their achievement. The examination consists of 40 multiple-choice questions with a time allowance of 80 minutes and emphasizes manipulative skills.

In the fall of 1971 the Mathematical Association of America approved a request by the National Contest Committee that a U.S.A. Mathematical Olympiad be held. The 1972 AHSMC held on March 14 was used as a run-off; the top-ranking 106 students were invited to participate in the first Olympiad held on May 9; 100 actually did. The examination consisted of five essay-type questions with a time allowance of three hours and was designed to test abstract reasoning. Needed for solution of the problems was no more than the knowledge of elementary high school mathematics; but that knowledge had to be cleverly and adroitly used.

The top-ranking eight students in the Olympiad were considered winners. Listed below are their names, schools, locations and ranks.

Rank	Name	School	Location
1	James Benjamin Saxe	Albany High School	Albany, N.Y.
2	Thomas Scott Hemphill	James Monroe High School	Sepulveda, Cal.
2	David H. Vanderbilt	Garden City High School	Garden City, N.Y.
3	Arthur L. Rubin	West Lafayette High School	West Lafayette, Ind.
3	Paul D. Harrington	Paul V. Moore High School	Central Square, N.Y.
4	Steven J. Raher	Central High School	Sioux City, Iowa
4	David Jay Anick	Ranney School	New Shewsbury, N.J.
5	James Bergheim Shearer	Livermore High School	Livermore, Cal.

David Jay Anick was only a high school junior and aged 15 at the time of taking the Olympiad.

On September 12 and 13 these eight winners were honored in ceremonies in Washington, D.C. The opening ceremony was held in the Board Room of the National Academy of Sciences; awards were presented and Dr. Emanual R. Piore, Treasurer and Member of the Executive Council of the Academy delivered the First U.S.A. Mathematical Olympiad Address entitled, "Relevancy". This was followed by a reception and dinner in the Diplomatic Reception Rooms of The Department of State. Several parents of the winners along with senatorial and congressional representatives of the States and districts respectively from which the winners came, representatives of scientific organizations, and members of the Olypiad committee were in attendance. The next day the group enjoyed a private tour of The White House, and were received by Dr. Edward E. David, Science Advisor to the President who also addressed the group and answered questions posed by the winners. The party then travelled to the National Bureau of Standards in Gaithersburg, where they were entertained at luncheon as guests of Dr. Burton H. Colvin,

Chief, Applied Mathematics Division and Dr. Lawrence Kushner, Acting Director. The program in the afternoon, arranged by Dr. Colvin, consisted of lectures by Dr. Alan J. Goldman, Dr. Wesley Nicholson, and Dr. R. A. Kirsch. The ceremonies associated with the awards presentation were made possible by a grant from the IBM Corporation.

-- Nura D. Turner

CBMS REPORT ON INFORMATION NEEDS IN THE MATHEMATICAL SCIENCES

Information Needs in the Mathematical Sciences, a report of the CBMS Committee on a National Information System in the Mathematical Sciences (NISIMS), was recently completed and submitted to the National Science Foundation. The report has also been submitted to the CBMS Council for its official endorsement and has been distributed to key officers and publications officials of the mathematical professional societies, which cooperated in the development of the report's studies and recommendations. Summarizing the results of a two-year effort by the Committee, the report delineates the specific information requirements of the mathematical community as components of an organized structure, with recommendations as to priorities for these various components. Included is a compilation of needed information services as determined by the various professional societies in the mathematical sciences and by several studies commissioned by the Committee (see the January 1972 CBMS *Newsletter*, pp. 13-15).

The report takes account of the need for multiple-use machine-readable data bases with compatible classification schemes and formats and offers a framework for a systematic development of information services in the mathematical sciences. Considering the primary research literature as a continuing responsibility of the professional societies and other publishers, the report concentrates primarily on comprehensive literature access, including secondary (abstracting/reviewing) services, tertiary services (indexes, title lists, and bibliographies), and general supporting services. The component services presently recommended by the Committee, grouped by priorities and with proposed responsible organizations indicated, are as follows.

The highest priority, with a recommendation of immediate implementation, has been assigned to (1) the development of a cooperative undertaking by AMS, SIAM, and other societies to provide complete abstracting/reviewing services for the entire mathematical sciences community; (2) automated input and expansion of the *Index to Mathematical Papers* to provide full coverage of the mathematical sciences [AMS]; (3) development of mechanization techniques for production of further classified cumulative review volumes in selected subfields [AMS]; (4) development of mechanization procedures for cumulative subject and author indexes of expository journals [MAA]; (5) evaluation of the prospective trends in the economics of primary publication [CBMS]; and (6) continuation of the coordination of planning and the assessment of further information needs [CBMS].

High priority, with a recommendation for early implementation, has been given to (1) an abstracting service for expository papers [MAA]; (2) a (related) title service for expository papers [MAA]; (3) critical surveys of alternative methods for computation of special functions [SIAM]; (4) investigation of access problems in fields interfacing with other disciplines [CBMS]; (5) annotated bibliographies for selected subfields [AMS]; (6) lists of recommended library holdings for selected subfields [AMS]; (7) preparation of a guide to the serial literature of the mathematical sciences [AMS]; (8) experimentation with classification and repackaging of selected abstracts and reviews from diverse sources, in areas interfacing with other disciplines [CBMS]; and (9) a cost/benefit analysis of several methods of retrospective indexing [CBMS]. (cont. next page)

A third category of projects recommended for implementation when funding permits includes: (1) development of expository surveys of mathematical research and establishment of an expository research journal [AMS]; (2) translation and publication of foreign-language expository works of merit [MAA]; (3) preparation of interdisciplinary advanced texts oriented toward users in other disciplines [AMS]; (4) experimentation with alternative classification and indexing schemes [AMS]; (5) preparation of an up-dating supplement to the *Index to Statistics and Probability* [R&D Press]; and (6) development of mechanization techniques for abstracting and indexing the history of mathematics.

SURVEY OF UNDERGRADUATE MATHEMATICAL EDUCATION ISSUED BY CBMS

CBMS has just published the fourth volume, *Undergraduate Education in the Mathematical Sciences, 1970-1971*, in the series of reports by its Survey Committee. (Some early undergraduate course-enrollment data from this latest survey appeared in the May 1972 CBMS *Newsletter*, page 14.) Authored by John Jewett and C. Russell Phelps with the technical assistance of Clarence B. Lindquist, this new volume is a sequel to the first of the series, *Aspects of Undergraduate Training in the Mathematical Sciences*, by Jewett and Lindquist, which provided comprehensive information on undergraduate mathematical education as of 1965-66 in four-year colleges and universities and in junior colleges. The present volume presents descriptions and analyses of course enrollments, faculty and other aspects of undergraduate programs and their changes over the last ten years, based on a survey of 400 departments of mathematics, statistics, computer science, and other mathematical fields in a stratified sample of 342 U.S. universities, colleges, and junior colleges. Sample-response data have been multiplied by appropriate amplification factors to provide data for the 1,369 degree-granting colleges and universities and 1,003 two-year institutions in the country. The text of 109 pages includes 71 tables and provides comprehensive information on enrollments in 75 specific undergraduate courses, admissions and placement practices, curricular innovations, computer utilization and other matters. It also gives data and discussion on the size and qualifications of departmental faculty and faculty supply and demand. The study was supported under a grant from the National Science Foundation. Copies are now available from CBMS (see inside back cover).

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